

HAROLD HANNIBAL (1889 - 1965)
with a Review of his Molluscan Research

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(5 Plates)

HAROLD HANNIBAL SPENT a meteoric career in Tertiary paleontology, and in studying living and fossil freshwater mollusks, during the early years of this century. His brilliant early work was tragically cut short, and he passed more than half his life in a mental institution only a few miles from his birthplace. Today he is remembered mainly through colorful stories dating from the period of his illness. We have combined a summary of the species he described and new illustrations of the type specimens with a short account of his life.

The virtual lack of contemporaries who knew Hannibal, the absence of personal records in his surviving field notebooks, and the few scientific contacts that he had, force a biographer to rely almost entirely on the published record and on the letters preserved in the files of the U. S. National Museum. For the rest we have only second-hand stories, his specimens and books at Stanford University, and a few bald circumstantial records. Our account of his work is thus partly inference and personal evaluation.

Harold Briggs Hannibal was born at Bay Tree Farm near the present town of Alviso, Santa Clara County, California, on November 27, 1889. Of his early life we have no record, and depend on the implications of his knowledge and interests shown in letters beginning in 1907, when he was not yet 18 and then in his senior year at San Jose High School. We quote extensively from his letters for two reasons: to let him speak for himself to the modern reader, and to record some of his observations and locality information that are otherwise inaccessible.

ACKNOWLEDGMENTS

Opportunity to borrow and study both notebooks and specimens is due to A. M. Keen, Department of Geology, Stanford University, and J. W. Durham, Museum of Paleontology, University of California. Photographs are by K. Sakamoto, U. S. Geological Survey, Menlo Park, California. Joseph Rosewater, U. S. National Museum, made available copies of Hannibal's letters. L. G. Hertlein, California Academy of Sciences, and A. M. Keen discussed the allocation of some of Hannibal's marine species based on poorly preserved material. Dorothy Radbruch, U. S. Geological Survey, Menlo Park, advised on the stratigraphic position of some fossil localities in the Berkeley Hills, California.

EARLY LIFE AND WORK

Hannibal's first scientific discovery was the freshwater mussel named in his honor by William Healey Dall: *Gonidea angulata haroldiana* DALL, 1908. Perhaps this is what turned him definitely toward freshwater mollusks, for he already had greater familiarity with the marine fauna (letter to Dall, 22-X-1907). At any rate, he turned to freshwater species – fossil and living – with prodigious energy. He graduated from high school in January, 1908; within three years he had published five papers, including the summary of western freshwater mollusks in Keep's "West coast shells." After another two years he had pub-

lished a thorough treatment of the southern California fauna, and his "Freshwater Mollusca of the Californian Province." This in addition to school work at Stanford University, field studies in geology as well as the living fauna, and a paper in paleobotany. One wonders if he ever slept. But by the end of 1912, at the age of 23, Hannibal had most of his writings behind him. Perhaps in part he simply burned himself out.

In the fall of 1907 Hannibal sent some freshwater mussels to the U. S. National Museum for identification. This led to correspondence with W. H. Dall to whom Hannibal wrote in the earliest letter we have seen:

"I am deeply interested in palaeontology and am about to take up some work suggested by Dr. J. P. Smith on the Santa Clara lake beds around this valley. I expect to work more or less in connection with S. S. Berry of Stanford Univ. who is working on the living Pulmonates.

"On account of lack of material and poor identification of what there is I find it will be necessary to send specimens to you for identification at least to start in with for while I am more or less familiar with the generic characters of marine shells, I have no comparative collection or any work on the fresh water except Keep, W. A. S. [West American shells]" (22-X-1907).

In December, 1907, Dall wrote Hannibal that the mussels were a new variety to be named *haroldiana*. The local excitement is shown by a note in the San Jose (California) Times, December 12: "High School Lad is Conspicuously Honored." Dall's description was published the following month, January 28 (DALL, 1908). That spring Hannibal began to search elsewhere for "his" variety as well as other mussels:

"I have extended the distribution of my variety to the following:

Coyote Creek, San Jose to S. F. Bay

Guadalupe Creek, San Jose to Sta. Clara

Quito Creek, or Campbells Creek, Sta. Clara to S. F. Bay

Above these towns there is no water in the creeks in summer as that is as far up as the artesian belt extends. From Sta. Clara to the bay in the Guadalupe there is sewage (no septic tanks either) and my variety being particular about its food died out. Tho' my father remembers when he used to make soup and chowder from them when a boy." (Hannibal to Dall, 24-IV-1908).

"I have another geographic variety of *Gonidea angulata* very triangular about 3 in. long with hinge teeth in adult, somewhat more angular than mine rather thin shelled and slender from the Pacheco (Pass) Creek between Santa Clara & San Benito Counties. The habitat is almost identical also the associated species *Anodonta nuttalliana* var.

"I have also collected *Margaritana margaritifera* in the San Lorenzo River on a special trip to the locality on learning it occurred there from an old paper sent me by Dr. Stearns [R. E. C. Stearns]. Both the purple and orange forms occur but the latter predominates. It is not a very common species,

two hours collecting at Felton and Boulder only yielding 14 specimens." (Hannibal to Dall, 7-VII-1908).

In this letter too Hannibal mentions some specimens of *Lyonsia* that were evidently what DALL (1915) later described as *Lyonsia californica haroldi*.

In the fall of 1908 Hannibal entered Stanford University. He wrote concerning his extracurricular work:

"I am working strictly on fresh water shells and fossils when not assisting in the palaeontology laboratory where I am arranging and labeling the collection of the late Miss Annie Laws which has been loaned the department by her heirs. When that is done there is the department collection of shells and the Delos Arnold collection so I will have enough to do as long as I am here." (Hannibal to Dall, 26-X-1908).

No notebooks or itineraries are available for Hannibal's collecting in southern California, but evidently this work occupied him in parts of 1909-1910. He published a summary of the freshwater mollusks, and of the land mollusks jointly with H. M. Edson (HANNIBAL, title 8). Perhaps Hannibal also collected fossils during this tour of southern California, but if so, we have no record.

During the summer of 1911 Ralph Arnold commissioned Harold Hannibal to collect fossils and make stratigraphic studies along the northwestern Pacific Coast. This was the first of several such mutually profitable ventures, leading to a substantial stratigraphic work by Arnold and Hannibal in 1913 (HANNIBAL bibliography, no. 11). Although Hannibal planned to describe the collections together with Arnold, untimely illness prevented this work. The only published results of these trips by Hannibal are a few fossil freshwater species (HANNIBAL bibliography, no. 9).

This first trip for Arnold is more carefully documented than later ones, perhaps because Hannibal wanted to prove he spent his sponsor's money prudently. Here is the first page from his expense account of 1911:

| | | |
|-------------|-------------------------------------|--------|
| Preliminary | Notebook, pencils, erasers, etc. | \$1.00 |
| | Pair of bike tires and supplies | 13.00 |
| | For \$100 worth of travelers checks | .50 |
| June 5 | Fare San Jose to S. F. | |
| | [San Francisco] | 1.50 |
| | Fare S. F. to San Rafael | 1.00 |
| | Photo supplies | .90 |
| | Meals | 1.15 |
| | Room | .50 |
| June 6 | Fare S. R. to Calistoga | 1.60 |
| | Meals | 1.50 |
| | Baggage by stage | .50 |
| | Room | .25 |
| June 7 | Meals | 1.50 |
| | Room | .25 |
| | Freight on box fossils | 1.00 |



*Yours Respectfully
Harold Hannibal.*



| | | |
|---------|-------------------------|------|
| June 8 | Meals | 1.50 |
| | Room | .35 |
| June 9 | Fare Ukiah to Sherwood | 2.00 |
| | Meals | 1.50 |
| | Bicycle repairs | 1.35 |
| | Baggage by stage | 1.30 |
| June 10 | Meals | 1.50 |
| | Room | .50 |
| | Freight on box spec. | 1.00 |
| June 11 | Meals | 1.65 |
| | Room | .50 |
| June 12 | Meals | 1.55 |
| June 13 | Meals | 1.50 |
| | Packing boxes and paper | .60 |

Hannibal numbered serially the localities at which he collected Recent mollusks on this 1911 trip, beginning with number 1 on June 5, and ending with number 96 on August 26, 1911. Some sample entries follow:

1. Drain from N end RR tunnel 1 mi N of San Rafael, $\frac{1}{2}$ mi S of Forbes. *Segm.[entina] dilat[ata]* & *Physa*. [June 5, 1911]

25. Third watertrough about 8 mi. N of Harris 3 mi S of Vances house. *Corneocyclas*. [June 11, 1911]
p. 8

47. Collect *Goniobasis* clinging to sea cliffs wet from seep water $\frac{1}{2}$ mi SE of Cape Blanco. [June 23, 1911]

The localities at which Hannibal collected can practically all be located precisely on modern topographic maps by following his notebook and tracing the itinerary. This much cannot be said for many subsequent collectors, or even for a substantial amount of present-day publications. Thus his collections are of value by modern standards, and of course particularly where later cultural changes have eliminated the former molluscan fauna. The high quality of these basic data recorded by Hannibal is one of the standards by which we rate him high as a malacologist.

This 1911 field trip produced a multitude of stratigraphic and paleontologic data. Hannibal's correspondence with Dall shows the exchange of numerous ideas on identity of fossils and the classification and nomenclature of both fossils and formations. In reply to a letter from Dall, Hannibal wrote (7-III-1912) from Seattle, Washington:

"I surely appreciate your admonition in regard to caution. Up in this country where one scratches around in the devil's club [a kind of spiny shrub] and fallen fir logs for a creek that has trenched down through the glacial drift and the fossils when one gets them look more than half the time like they had been hit by a steam roller at high-speed, geological work is something that isn't polite to mention in public."

In early 1912 Hannibal was completing his largest work, "A synopsis of the Recent and Tertiary freshwater

Mollusca of the Californian Province." The only pre-publication mention in Hannibal's letters is included in correspondence to Dall (7-III-1912):

"I am just finishing up the last of a general paper on the west coast fresh water forms straightening out the worst of the nomenclature and describing a number of new forms and decided to take a hand in the Pleuroceridae mess. You know what it is! Pilsbry seems to have given it up in disgust and no one else has had the gall to attempt it. I have plenty of material and have been able to get the species and genera in good shape - compared with what they were before at least. ..."

The *Synopsis* was submitted for review to some of the faculty in the Department of Geology at Stanford University, and so came - unbeknownst to Hannibal - to S. S. Berry. Dr. Berry recalls that he thought the paper contained some original and suggestive insights, even a few inspired ideas. Yet there were serious flaws, too, and he recommended that the paper not be published in its present form. Nevertheless it appeared soon, and with no substantial revision, in the *Proceedings of the Malacological Society of London*. Two features of Hannibal's paper appeared - and still appear - largely unwarranted: the sweeping union of many species under a single name, and the undocumented assertion that water chemistry is responsible for the nominal "species."

Shortly after the *Synopsis* appeared in print, H. A. Pilsbry published a savagely critical review in the *Nautilus* (volume 26, page 71). He called the *Synopsis* a fantastic farce, and violated good taste as well as good judgment in roundly damning it. One might suppose that Hannibal would have been furious, hurt, or somehow affected strongly. And yet in a letter to Paul Bartsch not long after he sounds quite mild:

"Am much obliged for the papers and will return the compliment shortly with a copy of the one that Pilsbry recently made notorious. Personally I think that our Philadelphia friend will regret that he did not wait till I "played my other hand" to use a sporting expression. I certainly never intended to shoot all my ammunition in this one paper and if he had read it carefully he might have noticed it." (24-XII-1912).

A more balanced review of Hannibal's *Synopsis* than that by Pilsbry appeared in the Pomona College *Journal of Entomology and Zoology* for 1913. Written by Fordyce Grinnell, Jr., an entomologist, not a mollusk specialist, this note shows how someone who evidently knew Hannibal at second hand, or perhaps had met him personally, regarded the work:

"The author of this paper, a young and very enthusiastic Stanford student, has covered a good portion of the Pacific Coast from San Diego to Seattle, with his bicycle, in search

of shells; investigating every puddle, pool, pond, lake, ditch, stream and river in his trips. He has collected material in large quantities and then studied it in the laboratory; so from training and experience he is more capable of writing on the fresh water shells of this coast than anyone. This, the most extensive of his published papers, is full of original ideas, and numerous suggestions. He first gives the boundaries of the California province in detail, then the composition of the fauna as found in the paleontological history of the region; thirdly, the classification employed; fourthly, the new term *Syntonia* is explained in detail; then lastly taking up most of the paper, the synopsis of species, in which the groups from the superfamily to species are defined. There is a full bibliography and synonymy for the genera and species; a table showing the Evolutionary Cycle of the Unionoideae, and a summary and range in time of the California fauna, and concluding remarks.

"Of course, a student with such radical ideas, a progressive, could not escape the fire of one or more of the conservative men; and this is just what happened in a recent number of *The Nautilus*. If you wish to smile, just look it up!"

Although keeping a strong interest in freshwater species, Hannibal devoted his field work and research from 1912 on primarily to marine Tertiary paleontology and stratigraphy. Probably this was due in part to the sponsorship of Ralph Arnold, who employed or subsidized him as a collector. Hannibal made headquarters at the University of Washington during most of 1912, and went on short field excursions to points on Vancouver Island as well as coastal Washington. He returned to Stanford in October, 1912, and seemingly did no more field work outside of California. He wrote to Dall (29-IV-1913):

"Expect to work northern California this year and perhaps as far south as San Louis [sic] Obispo using a motorcycle to travel with. Of course I will watch out for the festive mollusk that inhabits the beaches and rocks."

Evidently about 1914 came the first of Hannibal's serious mental disturbances, that were to force him into an institution. After a lapse in correspondence Hannibal

wrote Dall (23-VIII-1916, dated at home instead of, as usual, Stanford University):

"Have been drifting through a case of remittent brain fever the last two years and not doing much scientific work. Hope to get back into it this winter, however . . .

"Have just learned from Dr. [J. O.] Snyder that of La Honda, Pescadero and San Lorenzo Rivers in which an isolated colony of *Margaritana* var. *falcata* occurs — the nearest other points being Merced Falls, and Long Valley Creek, Lake Co., La Honda and Pescadero Creeks contain no fluviatile fishes and San Lorenzo River only three minnows. It appears that this species utilizes one or more of the migratory Salmonidae or Cottidae as a host for the glochidia, presumably the former from the peculiarities of the distribution of *Margaritana*. There seems to be a chance that these colonies were originally established by glochidia brought from more northern streams by the open sea route.

"Conditions are rather indifferent for research work at Stanford this year. Dr. Wilbur had a good deal of success at the medical school but since he became president it has been a mad scramble for credits and an increased tendency to interfere in student affairs. Instead of a big man like Jordan or Branner who is unapproachable or a man with ideals like Wilbur they need a business man like Arnold who commands the friendship and respect of students and faculty and can gum-shoe around and get ideas from Tom, Dick, and Harry and have his sails set when the wind blows.

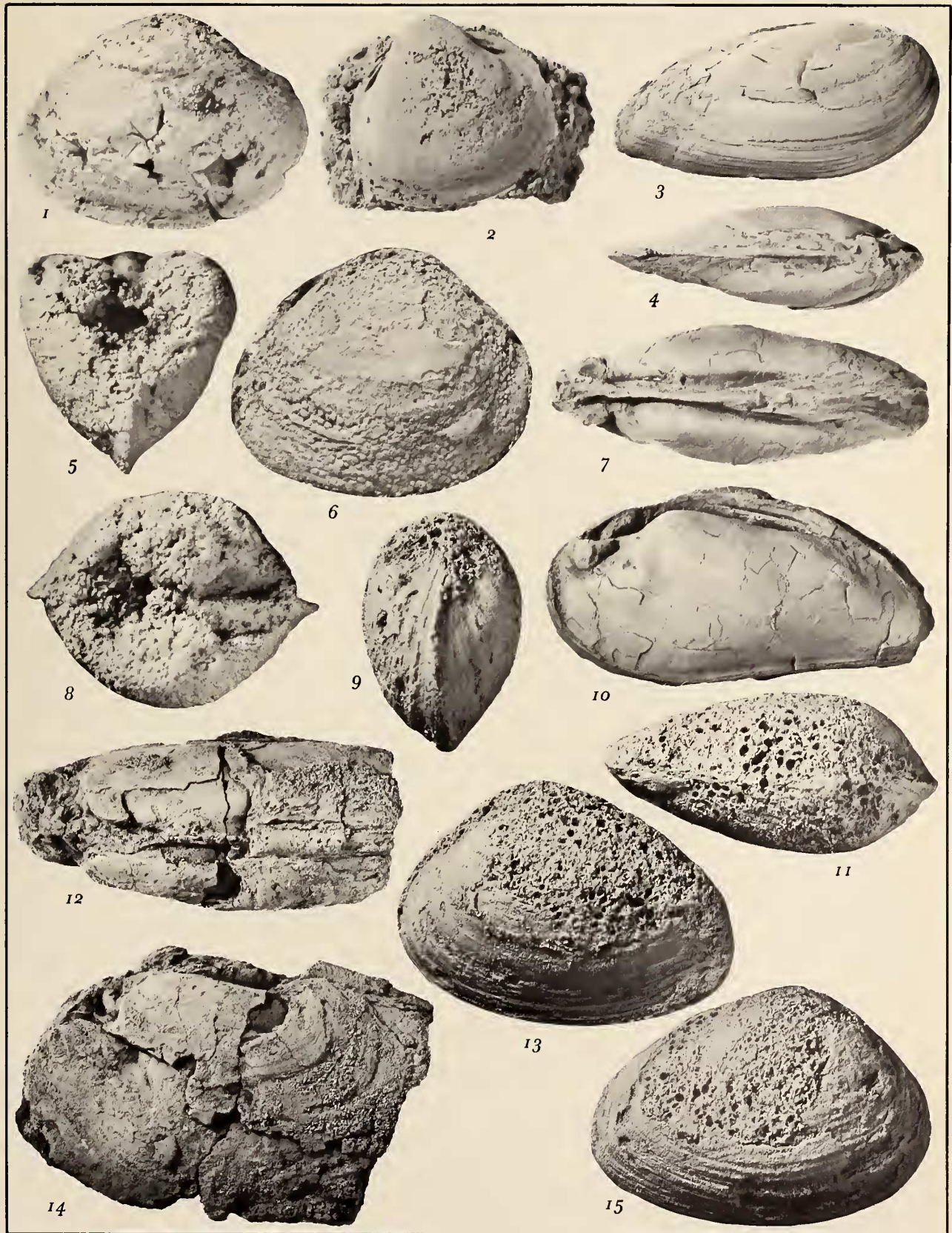
"I suppose Mrs. Oldroyd must be back at Stanford by this time but I haven't been there for several weeks. I couldn't quite make out what she was doing but she seems to have got some cases to house the shell collections which was more than I was able to do."

Recurrent mental problems gradually forced Hannibal's scientific work to a close. After the large paper by Arnold and Hannibal in 1913 (HANNIBAL bibliography, no. 11) his scientific publications consist of only a few short notes.

After a long lapse during which he apparently did not communicate with any scientific colleague, Hannibal corresponded at some length with G Dallas Hanna of the California Academy of Sciences. The letters are a mixture

Plate Explanation

- Figures 1, 5, 8: *Pisidium catherinae* (HANNIBAL, 1912b), Miocene, Holotype, SU 5816 × 10
 Figure 2: *Sphaerium mecki* (HANNIBAL, 1912b), Miocene. Holotype, SU 450 × 3
 Figures 3, 4, 7, 10: *Plesielliptio transpacificae* (ARNOLD & HANNIBAL, in HANNIBAL, 1912b), Eocene × 1
 3, 4: Holotype, SU 454
 7, 10: Paratype, SU 453
 Figure 6: *Sphaerium andersonianum* HANNIBAL, 1912b, Pliocene. Holotype, SU 299 × 3
 Figures 9, 11, 13, 15: "*Sphaerium*" *rogersi* HANNIBAL, 1912b, Eocene. Holotype, SU 457 × 3
 Figures 12, 14: "*Margaritifera*" *herrei* HANNIBAL, 1912b, Eocene. Holotype, SU 452 × 1





of lucid memories of early collecting and research, together with sad fantasies about the current world. This exchange of letters terminated with Hannibal's death on December 17, 1965. He is survived by a sister, Edna-Ann Hannibal Wagoner, and by a half-brother, Arthur Alton Hannibal.

The collection of freshwater mollusks, the library, and a few notebooks that Hannibal left are housed in the Department of Geology, Stanford University. We have found all of the type specimens that he described, and illustrated most of them herein.

A PARTIAL APPRAISAL

Harold Hannibal's ability and energy are indicated partly by the diversity of the fields in which he worked. He published papers dealing with vertebrate paleontology, paleobotany, and marine Tertiary stratigraphy, besides his principal efforts in the classification and distribution of fossil and living freshwater mollusks. Most of this work appeared within five years after he was graduated from high school, so one can scarcely fault his industry. As to the quality of Hannibal's work we have tried to appraise only his efforts in nonmarine mollusks: their classification and distribution.

The basic data that Hannibal collected and published remain valuable and detailed in spite of possible different interpretations. One can find readily where he collected, and the specimens he left are in good order, clearly labeled. All of his type specimens survive.

In the description of new species one cannot rate Hannibal quite so high. He gave 29 names to species and varieties. About one-fourth of these appear superfluous. Further, a few were sadly misclassified. The "ancylicid snail" *Zalophancylus morani* turned out to be the mold of a fish vertebra. *Gonidea hemphilli* and *Sphaerium rogersi* are not freshwater species but belong to entirely different, marine families of clams. The photographs of the new forms were mostly inadequate even when published originally — a major stimulus for preparation of our present paper.

Out of 12 new genera and subgenera that Hannibal proposed, nearly half have not proved useful to later workers. Only the fish vertebra, *Zalophancylus*, could be called an outright blunder. The other needless names apply to groups that others have ranked lower than did Hannibal.

Of 11 family or subfamily names proposed by Hannibal only about one-fourth survive. Some have vanished because of later nomenclatural changes. Most of the useless names were proposed for groups that were founded on too few characters to survive further research, or that

were interpreted by Hannibal as phylogenetic units in his "ontogenetic classification."

The zoogeographic treatment of the West American fauna that Hannibal published in 1912 remains a high-water mark. Subsequently the tide has receded, so far as quality of work is concerned. From DALL (1905a, b) Hannibal took the idea of grouping the freshwater mollusks into drainage "Systems." These were drainages, or groups of drainages, with a generally similar fauna. Thus in the "Californian Province" there were the Yukon System, Coast Range System, Inland Empire System, Los Angeles System and the like.

To this scheme one can contrast the molluscan provinces described by HENDERSON (1931). An obvious difference is the neat coincidence of some of Henderson's "provincial" boundaries with the political boundaries of states — the southwestern edge of Nevada, the southern edge of Utah and Colorado, and the like. More seriously, Hannibal's earlier discussions and characterizations of the aquatic fauna were not even mentioned. The fundamental reason why Hannibal's earlier work is likely to prove more lasting than Henderson's classification was well stated by DALL (1905b): "The distribution of water animals is carried on by different means from those influential in the dispersal of terrestrial forms, and any discussion which combined the two without distinction would be liable to contain errors of fact and deduction." Just as Henderson failed even to mention Hannibal's work, so too he did not cite Dall's paper or advance justification for establishing "provinces" for both terrestrial and aquatic forms.

A final question remains: What led to Hannibal's illness? We have no satisfactory answer. In his published works and unpublished letters prior to the first mental troubles we see no evidence of derangement. His views are original, and often unacceptable, but evidently reasoned. Leo G. Hertlein has repeated to us a story heard from the late J. P. Smith, one of Hannibal's teachers at Stanford. Thrown from his motorcycle on a rough road, Hannibal fell on his head. Only thereafter did his first mental problems appear, then gradually worsen and eventually force him to leave the field of science that he had begun to till so energetically.

SUMMARY OF NEW MOLLUSCAN NAMES

Hannibal proposed altogether 52 new names for Mollusca, from family to variety. We have summarized the current taxonomic standing of these, provided new illustrations of most of the type specimens, and relocated a number of type localities in the light of stratigraphic studies and topographic maps available since Hannibal's work.

In the following list Hannibal's names are cited as he proposed them. The grouping by family is modern, and shows the order in which we discuss the names. References to illustrations indicate those type specimens figured herein.

PELECYPODA

| | | |
|---|-----------------------|--|
| MARGARITIFERIDAE | | |
| <i>herrei</i> , <i>Margaritana</i> | Figures 12, 14 | |
| AMBLEMIDAE | | |
| <i>Limnobasilissa</i> | | |
| UNIONIDAE | | |
| <i>Arnoldina</i> | | |
| <i>Migranaja</i> | | |
| Pleurobeminae | | |
| Propterinae | | |
| <i>transpacifica</i> , <i>Unio</i> | Figures 3, 4, 7, 10 | |
| SPHAERIDAE | | |
| <i>andersonianum</i> , <i>Sphaerium</i> | Figure 6 | |
| <i>catherinae</i> , <i>Sphaerium</i> | Figures 1, 5, 8 | |
| Corneocycladidae | | |
| <i>meekei</i> , <i>Corneocyclas</i> | Figure 2 | |
| <i>tremperi</i> , <i>Corneocyclas</i> | | |
| HIATELLIDAE | | |
| <i>hemphilli</i> , <i>Gonidea</i> | Figures 38, 39 | |
| VENERIDAE? | | |
| <i>rogersi</i> , <i>Sphaerium</i> | Figures 9, 11, 13, 15 | |

GASTROPODA

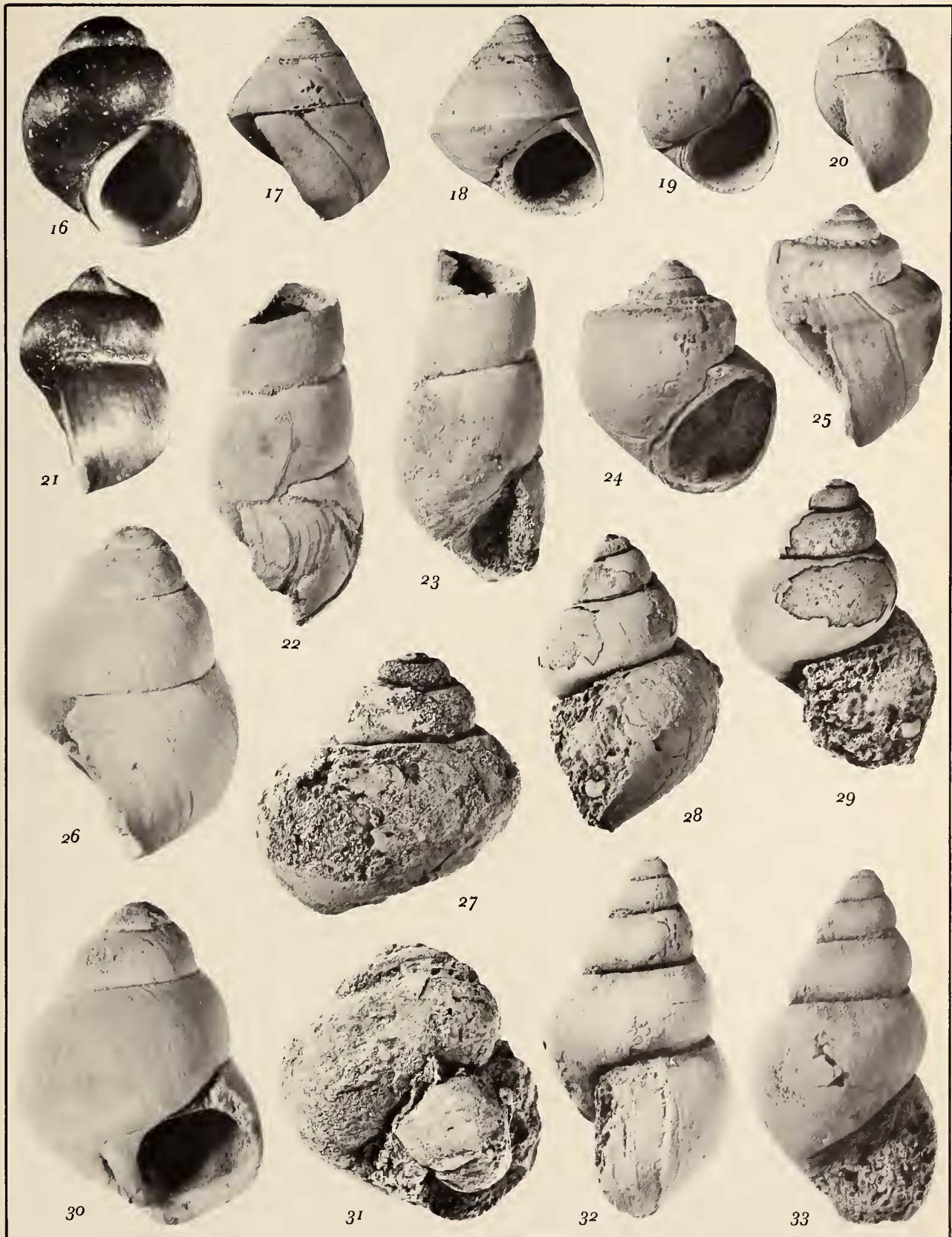
| | | |
|---|------------------------|--|
| VALVATIDAE | | |
| <i>calli</i> , <i>Valvata</i> | Figures 47, 48, 51, 52 | |
| <i>whitei</i> , <i>Valvata</i> | Figures 45, 46, 50 | |
| VIVIPARIDAE | | |
| <i>andersoniana</i> , <i>Lioplax</i> | Figures 32, 33 | |
| <i>Callina</i> | | |
| <i>Cipangopaludina</i> | | |
| <i>turneri</i> , <i>Viviparus</i> | Figures 27-29, 31 | |
| <i>washingtonianus</i> , <i>Viviparus</i> | Figures 26, 30 | |
| BITHYNIIDAE | | |
| Bulimididae | | |

| | | |
|--|------------------------|--|
| PLEUROCERIDAE | | |
| Ellipstomidae | | |
| Gyrotominae | | |
| <i>olequaensis</i> , <i>Ambloxus</i> | Figures 22, 23 | |
| THIARIDAE | | |
| <i>drakei</i> , <i>Pachychilus</i> | Figures 41, 42 | |
| HYDROBIIDAE | | |
| <i>binneyana</i> , <i>Cincinnatia</i> | | |
| <i>Heathilla</i> | | |
| <i>modoci</i> , <i>Fluminicola</i> | Figures 16, 17 | |
| <i>williamsi</i> , <i>Pyrgulopsis</i> | Figures 18-21, 24, 25 | |
| LATIIDAE | | |
| Latiinae | | |
| LANCIDAE | | |
| <i>Fisherola</i> | | |
| <i>klamathensis</i> , <i>Lanx</i> | | |
| <i>lancides</i> , <i>Fisherola</i> | Figure 34 | |
| Lancinae | | |
| <i>Walkerola</i> | | |
| LYMNAEIDAE | | |
| Acellinae | | |
| <i>cooperi</i> , <i>Lymnaea</i> | Figures 36, 37, 40 | |
| <i>lawsoni</i> , <i>Pachychilus</i> | Figures 43, 44 | |
| <i>sanctijosephi</i> , <i>Lymnaea</i> , <i>cubensis</i> var. | Figure 35 | |
| <i>stearnsi</i> , <i>Lymnaea</i> | | |
| ANCYLIDAE | | |
| <i>Kincaidilla</i> | | |
| Laevapecinae | | |
| <i>morani</i> , <i>Zalophancylus</i> | | |
| PLANORBIDAE | | |
| <i>Brannerillus</i> | | |
| <i>cordillerana</i> , <i>Helisoma</i> | Figures 57, 58, 60, 61 | |
| <i>mojavensis</i> , <i>Planorbis</i> | | |
| Neoplanorbinae | | |
| <i>Perrinilla</i> | | |
| <i>physispira</i> , <i>Brannerillus</i> | Figures 49, 53 | |
| <i>sanctaclarae</i> , <i>Carinifex</i> | Figures 54-56, 59 | |

In the following summary of names proposed by Hannibal, the entry is divided usually into two parts. The first paragraph includes such objective data as original reference, illustration, and type locality. Later paragraphs include such modern or revisionary data as subsequent illustration of Hannibal's material, current stratigraphic

Plate Explanation

| | | |
|--|---|------|
| Figures 16, 17: <i>Lithoglyphus turbiniiformis</i> (TRYON, 1865), Recent. Holotype of <i>Fluminicola modoci</i> HANNIBAL, 1912b, SU 5777 | Figures 24, 25: <i>Savaginius williamsi</i> (HANNIBAL, 1912b), Pliocene. Holotype, SU 461 | × 5 |
| Figures 18, 19: <i>Savaginius percarinatus</i> (PILSBRY, 1934), Pliocene. Paratype of <i>S. williamsi</i> (HANNIBAL, 1912b), SU 466 | Figures 26, 30: <i>Bellamyia washingtoniana</i> (ARNOLD & HANNIBAL, in HANNIBAL, 1912b), Eocene. Holotype, SU 462 | × 3 |
| Figures 20, 21: <i>Savaginius perditicollis</i> (PILSBRY, 1934), Pliocene. Paratype of <i>S. williamsi</i> (HANNIBAL, 1912b), SU 465 | Figures 27, 29, 31: <i>Bellamyia turneri</i> (HANNIBAL, 1912b), Pliocene. 27, 31: Holotype, UCMP 12216 | × 1½ |
| Figures 22, 23: <i>Juga olequaensis</i> (HANNIBAL, 1912b), Eocene. Holotype, SU 459 | 28, 29: Paratype, SU 5902 | × 1½ |
| | Figures 32, 33: <i>Campeloma andersonianum</i> (HANNIBAL, 1912b), Eocene. Holotype, SU 463 | × 3 |





classification of the formation from which the type material came, and current taxonomic standing of Hannibal's name.

MARGARITIFERIDAE

herrei Hannibal, 1912, *Margaritana*. Proc. Malac. Soc. London 10: 121; plt. 7, fig. 17. One-fourth mile above Carnegie Pottery plant, in cut along Western Pacific Railway, Corral Hollow, Tesla, California; W. H. Ochsner, H. Hannibal.

Holotype SU 452; Figures 12, 14. The locality is in the Tesla Formation, of Middle Eocene age, as mapped by HUEY (1948), in the NE $\frac{1}{4}$ sec. 33, T. 3 S., R. 4 E., San Joaquin County, California. The type is poorly preserved, but may be *Margaritifera* (now preferred to *Margaritana*) or *Plesielliptio*. Same locality as *Campeloma andersonianum*. Hannibal's notebooks indicate that he collected here January 3, 1911.

AMBLEMIDAE

Limnobasilissa Hannibal, 1912. Proc. Malac. Soc. London 10: 127. Proposed as subgenus of *Gonidea*. No later author has found this name useful.

UNIONIDAE

Arnoldina Hannibal, 1912. Proc. Malac. Soc. London 10: 128. Proposed as genus of Unionidae, Anodontinae. Later authors have generally not maintained the group as valid, though MODELL (1964) ranked it as a genus of Unionidae, Rectidentinae. Anatomical investigations might indicate the name could be used for a genus or subgenus, but surely *Arnoldina* was instituted prematurely.

Migranaja Hannibal, 1912. Proc. Malac. Soc. London 10: 124. Proposed as genus of Unionidae, Unioninae. Nomenclatorially this name has fallen as a synonym of *Potomida* Swainson, 1840, of the Unionidae. Yet the American fossil that Hannibal dealt with is now classified in *Margaritifera*, of the Margaritiferidae. Both in taxonomy and nomenclature Hannibal's work in this instance was hasty.

Pleurobeminae Hannibal, 1912. Proc. Malac. Soc. London 10: 118, 120. Proposed as subfamily of Quadrulidae. No later author has retained this group. The name as used by MODELL (1964) refers to a widely different assemblage.

Propterinae Hannibal, 1912. Proc. Malac. Soc. London 10: 118, 120. Proposed as subfamily of Lampsilidae. No subsequent writer has found this group useful.

transpacifica Arnold & Hannibal, 1912, *Unio*. Proc. Malac. Soc. London 10: 123; plt. 7, figs. 18a, b. Bluffs along Olequa Creek at shoals, $1\frac{1}{2}$ miles above Little Falls, Washington; H. Hannibal.

Holotype SU 454; paratype SU 453; Figures 3, 4, 7, 10. Classified as *Plesielliptio transpacifica* (Arnold & Hannibal) by TAYLOR (in press). Hannibal's notebooks indicate that he collected in the Little Falls area from July 25 to August 2, 1911, and that is presumably when he obtained material of this species. The locality is in rocks now classified as Cowlitz Formation, of late Eocene age; the species was not listed by WEAVER (1943).

SPHAERIIDAE

andersonianum Hannibal, 1912, *Sphaerium*. Proc. Malac. Soc. London 10: 132; plt. 6, fig. 11. Badland Hills, one mile east of Sand Hollow, Oregon; R. B. Moran.

Holotype SU 299, Figure 6. Probably an earlier name for *Sphaerium malheureuse* Henderson & Rodeck, 1934. Probably from the lower and middle Pliocene Grassy Mountain Formation as described by KITTLEMAN *et al.* (1965).

catherinae Hannibal, 1912, *Sphaerium*. Proc. Malac. Soc. London 10: 132; plt. 7, fig. 20. Hill near Hawthorne on the Belmont stage-road, Nevada.

Holotype SU 5816, Figures 1, 5, 8. Probably an earlier name for *Pisidium leslieae* Firby, 1966, and a species of *Pisidium* (s. s.).

The type locality is evidently within the "beds near Hawthorne" where BUWALDA (1914: 351) found an assemblage of mollusks like that in the Esmeralda Formation of Stewart and Ione Valleys, Nevada. *Pisidium catherinae* (Hannibal), *Sphaerium meeki* (Hannibal), and *Perrinilla cordillerana* (Hannibal) were all described from the "hill near Hawthorne on the Belmont stage-road." Two of these were recorded by BUWALDA in the Esmeralda Formation of Ione and Stewart Valleys. All three appear to have been described as new by FIRBY (1966) from the upper Miocene-lower Pliocene Esmeralda Formation of Ione and Stewart Valleys, without comparison with Hannibal's species or discussion of Buwalda's identifications.

CORNEOCYCLADIDAE Hannibal, 1912. Proc. Malac. Soc. London 10: 133. Proposed as a family of "Cyrenoidea," that is, Corbiculacea in the current sense, in substitution for the prior name Pisidiidae which Hannibal considered unavailable. *Sphaerium* and *Pisidium* have generally been classified together in the SPHAERIIDAE by later authors.

meeki Hannibal, 1912, *Corneocyclas*. Proc. Malac. Soc. London 10: 135; plt. 6, fig. 12. Hill near Hawthorne on the Belmont stage-road, Nevada.